
# Mu of a Shoe (Friction) Lab

Name _____
Date _____

Lab Partner(s) _____

_____

## INTRODUCTION

Friction is a part of everyday life. There is an amount of force required to start an object moving. This force required is called_____ **friction**. There is an amount of force required to keep the object moving. This force is called _____ **friction.** Shoes have different types of soles and weights which affect the amount of friction that it normally acts on them during everyday life. Athletic shoes tend to have rubber soles and treads to resist slipping during running and jumping, while shoes meant for fashion can have lighter soles made of other materials because they're not meant to undergo strenuous physical activity. Additionally, different surfaces can have different amounts of friction: bumpy roads have more friction than an ice rink, for example. Because of this, the surface in the experiment will be kept constant throughout so that the results were accurate in determining how the mass of a shoe and the type of shoe affect frictional values.

## PURPOSE

1. Identify and measure the different types of friction that affect a shoe sliding across a ramp.
2. Predict and measure the forces due to changing the mass of the shoe.

## PRE-LAB QUESTIONS and PREDICTIONS

1. Will it take more force to start an object moving or to keep it moving?

2. Will there be more friction if the sole is touching the tab ramp or if the top is touching the ramp?

3. How will the force of friction compare to the weight of the shoe?

4. What will happen to the force of friction when you increase the mass of the shoe?

5. How does the force of friction change when the shoe is on a different surface?

6) Examine the shoes in your group which will have the most friction?

## MATERIALS

**Per Group**

- One shoe from each group member
- Ramp
- spring scales (zeroed)
- 1 kg masses

## PROCEDURE #1 Comparing static & dynamic friction on to types of surfaces

1) Weigh your shoes (in newtons) and record in a data table
2) Place the sole of your shoe on the ramp. Measure the amount of force ( in newtons) needed to get your shoe to start sliding on the ramp & record in the data table.
3) Measure the amount of force needed to keep your shoe to sliding on the ramp with the sole down & record in the data table.
4) Place the top of your shoe on the ramp (sole up ). Measure the amount of force needed to get your shoe to start sliding on the ramp & record in the data table.
5) Measure the amount of force needed to keep your shoe to sliding on the ramp with the sole up & record in the data table.
6) Place a 1 kilogram mass in your shoe and repeat the above procedures.

## DATA/OBSERVATIONS

**Data Table 1 - Shoe with sole (area) on ramp**

| Shoe (type or name) | Weight of shoe (and Masses) (N) | Static Friction Force (N) | Dynamic Friction Force (N) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## CONCLUSIONS

1. Does it take more force to start an object moving or to keep it moving?

2. How does shoe surface of the shoes contribute to friction?

3. How does the force of friction compare to the weight of the shoe?

4. What happens to the force of friction when you increase the mass on the shoe?

5. Which surface provides the least amount of friction? Explain

6. What are some possible problems with this experiment and how could you improve this experiment?

7. How do the coefficients of friction compare for the different surfaces you used?

*For High School Physics

**Going Further**

In order to get more reliable results you would need to do multiple trials for each mass on the box and average your results.

**TEACHER's GUIDE**
**FRICTION**

**CLASSROOM USAGE**

This lab can be used as a discovery lab or can be used as an extension of friction. This will work for middle school or high school lab. High School physics students should use the portion of the analysis that goes through the calculation of coefficients of friction.

**CURRICULUM INTEGRATION**

**Middle School Benchmarks Addressed by this Lab:**

7.3.17 – Investigate that an unbalanced force, acting on an object, changes its speed or path of motion of both, and know that if the force always acts towards the same center as the object moves, the object's path may curve into an orbit around the center.

**Physics Benchmarks Addressed by this Lab:**

P.1.7 – Use Newton's Laws together with the kinematic equations to predict the motion of an object.

**PREPARATION**

You will need to make sure that you have blocks of wood (or boxes), masses and various materials to put on the table.

**GETTING READY**

It is important for you to familiarize yourself with the use of the computer, Logger Pro and the force sensor.

Students will need to work in teams of 2-4 for this lab. It is very difficult for one student to complete this lab on their own.

**TIME**

This lab will take 2-5 class periods depending on the abilities of your students.

**SAFETY AND DISPOSAL**

There are no disposal issues with this lab.
Make sure students keep blocks and masses away from the edge of the table.

**VARIATIONS**

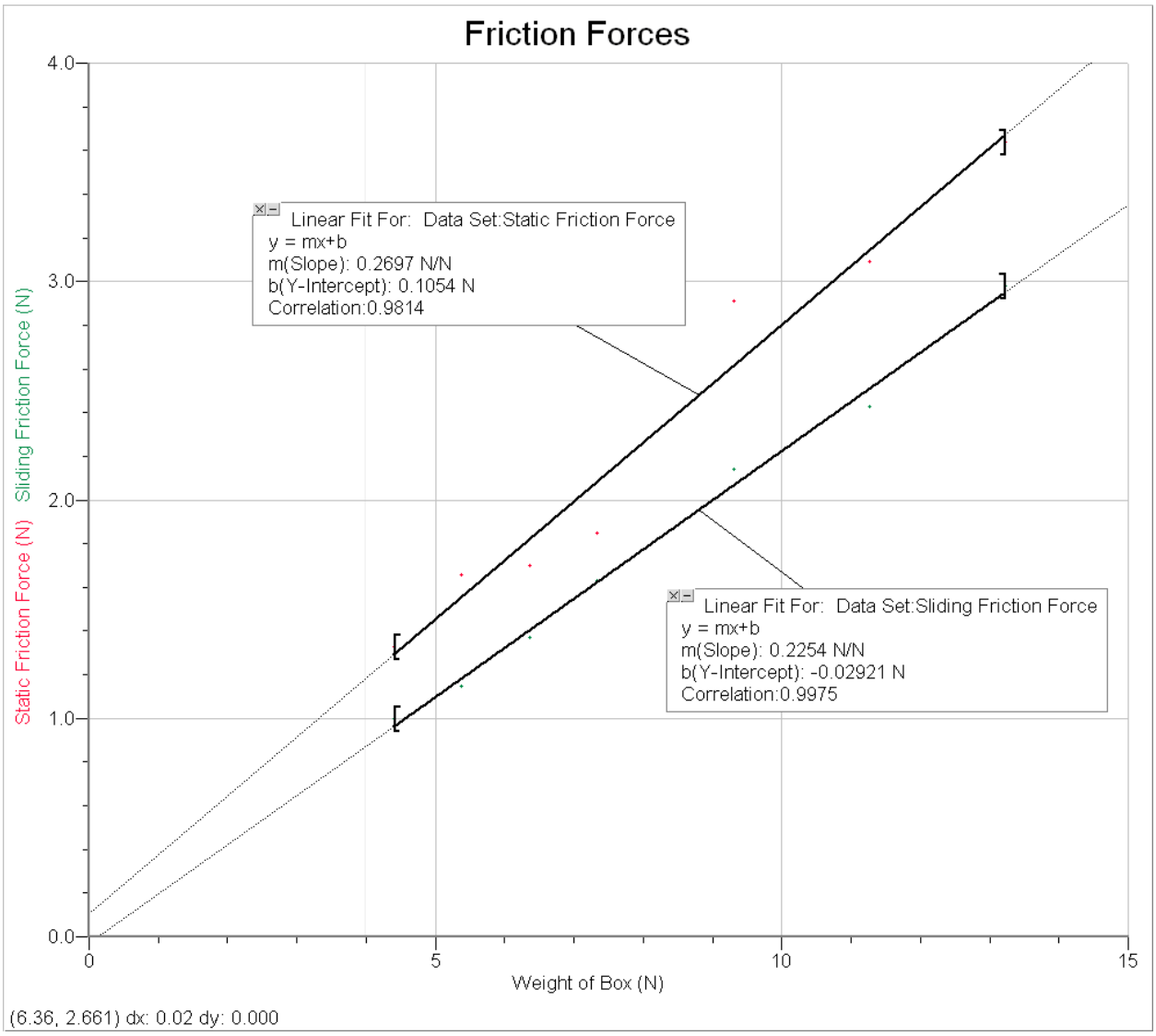
- **Students could try different boxes/blocks or other materials.**
- **Students could use a sloped surface and compare to the flat surface.**

**Sample Data**

Weight of box: **4.4 N**

**Data Table 1 - Block with Large area on Table**

| Mass added to block (g) | Weight of Block (and Masses) (N) | Static Friction Force (N) | Sliding Friction Force (N) |
|---|---|---|---|
| 0 | 4.4 | 1.33 | 1.0 |
| 100 | 5.38 | 1.66 | 1.15 |
| 200 | 6.36 | 1.70 | 1.37 |
| 300 | 7.34 | 1.85 | 1.63 |
| 500 | 9.3 | 2.91 | 2.14 |
| 700 | 11.26 | 3.09 | 2.43 |
| 900 | 13.22 | 3.64 | 2.98 |




Coefficient of Static Friction for box on table: 0.27
Coefficient of Sliding Friction for box on table: 0.23